



Operating Instruction

Modulating refrigerant valves with magnetic actuator, PS45

MVL661..EX

Hermetically sealed, for safety refrigerants

- One valve type for expansion, hot-gas and suction throttle applications
- Certification per ATEX Directive 2014/34/EU
- Test certificate: SEV 17 ATEX 0110 X
- Four valve sizes with k_{vs} values from 0.25 to 6.3 m³/h
- Selectable standard interface DC 0/2...10 V or DC 0/4...20 mA
- Short positioning time (< 1 s)
- Closed when deenergized
- Hermetically sealed towards outside
- Robust and maintenance-free

Use



II 3G Ex ec IIC T4 Gc

Refrigerant valve MVL661..EX is a device per ATEX Directive 2014/34/EU Appendix II from device group II category 3G that may be used per directive 99/92/EG (ATEX 137) in zone 2 as well as gas groups IIA, IIB, and IIC, at risk of explosion by flammable materials in the range of temperature classes T1 to T4.

The permissible ambient temperature range is -25°C to +55°C.
The housing must be protected against shock waves for a temperature range of -25 °C ≤ Tamb ≤ -15 °C. See Requirement "Environment" under Special conditions for protection against explosion, page 9.

Type summary

Type	Item no.	DN	k_{vs} [m ³ /h]	k_{vs} reduced ¹⁾ [m ³ /h]	Δp_{max} [MPa]	Q_0 E [kW]	Q_0 H [kW]	Q_0 D [kW]
MVL661.15-0.4EX	S55320-M106	15	0.40		2.5	47	9.2	1.7
				0.25		29	5.7	1.0
MVL661.15-1.0EX	S55320-M107	15	1.0			117	23	4.2
				0.63		74	14	2.6
MVL661.20-2.5EX	S55320-M108	20	2.5			293	57	10
				1.6		187	37	6.6
MVL661.25-6.3EX	S55320-M109	25	6.3			737	144	26
				4		468	92	17

¹⁾ The k_{vs} values and Q_0 refrigeration capacity can be reduced to 63% as needed, see " k_{vs} reduction" on page 4

k_{vs} Nominal flow rate of refrigerant through the fully open valve (H_{100}) at a differential pressure of 100 kPa (1 bar) to VDI 2173

Q_0 E Refrigeration capacity in expansion applications

Q_0 H Refrigeration capacity in hot-gas bypass applications

Q_0 D Refrigeration capacity in suction throttle applications and $\Delta p = 0.5$ bar

Q_0 With R407C at $t_0 = 0$ °C, $t_c = 40$ °C

The pressure drop across evaporator and condenser is assumed to be 0.3 bar each, and 1.6 bar upstream of the evaporator (e.g. spider).

The capacities specified are based on superheating by 6 K and subcooling by 2 K.

For accurate valve sizing, we recommend the valve selection program "Refrigeration VASP".

Ordering

Valve body and magnetic actuator form one integral unit and cannot be separated.

Example:

Type	Item no.	Designation
MVL661.15-0.4EX	S55320-M106	EX-certified refrigerant valve

Spare parts

ASR61EX

If the valve's electronics become faulty, the entire electronics housing must be replaced by spare part ASR61EX, supplied complete with mounting instructions (A5W00036611).

Rev. no.

See table on page 14.

Function / mechanical design

Features and benefits

- 4 selectable standard signals for setpoint and measured value
- DIP switch to reduce the k_{vs} value to 63% of the nominal value
- Potentiometer for adjustment of minimum stroke for suction throttle applications
- Automatic stroke calibration
- Forced control input for "Valve closed" or "Valve fully open"
- LED for indicating the operating state

Control

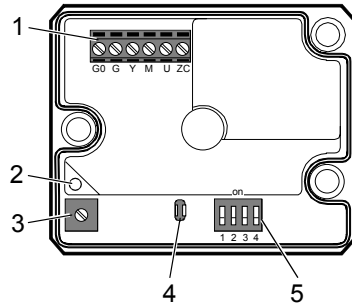
The MVL661..EX can be driven by Siemens or third-party controllers that deliver a DC 0/2...10 V or DC 0/4...20 mA output signal.

For optimum control performance, we recommend a 4-wire connection between controller and valve. When operating on DC voltage, a 4-wire connection is **mandatory!** The valve stroke is proportional to the control signal.

Spring return facility

If the positioning signal is interrupted, or in the event of a power failure, the valve's return spring will automatically close control path A → AB.

Operator controls and indicators in the electronics housing



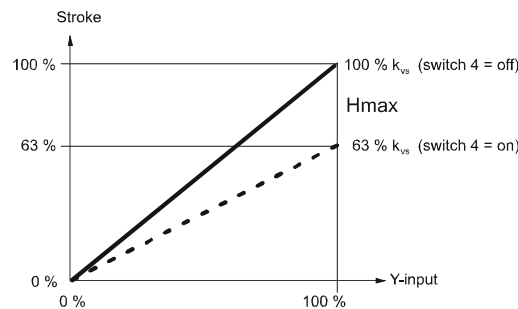
- 1 Connection terminals
- 2 LED for indication of operating state
- 3 Minimal stroke setting potentiometer Rv
- 4 Autocalibration
- 5 DIL switches for mode control

Configuration of DIL switches

Switch	Function	ON / OFF	Description
 1	Positioning signal Y	ON	Current [mA]
		OFF	Voltage [V] ¹⁾
 2	Positioning range Y and U	ON	DC 2...10 V, 4...20 mA
		OFF	DC 0...10 V, 0...20 mA ¹⁾
 3	Position feedback U	ON	Current [mA]
		OFF	Voltage [V] ¹⁾
 4	Nominal flow rate k_{vs}	ON	63%
		OFF	100% ¹⁾

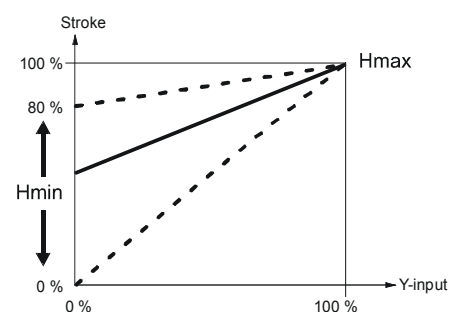
¹⁾ **Factory setting**

k_{vs} -reduction



For k_{vs} reduction (DIL switch 4 in position ON), the stroke is limited to 63% mechanical stroke. 63% of full stroke then corresponds to an input/output signal of 10 V. If, in addition, the stroke is limited to 80%, for example, the minimum stroke is $0.63 \times 0.8 = 0.50$ of full stroke.

Minimum stroke setting



In the case of a suction throttle valve, it is essential that a minimum stroke limit be maintained to ensure compressor cooling and efficient oil return. This can be achieved with a reinjection valve, a bypass line across the valve, or a guaranteed minimum opening of the valve. The minimum stroke can be defined via the controller and control signal Y, or it can be set directly with potentiometer Rv.

The **factory setting** is zero (mechanical stop in counterclockwise direction, CCW). The minimum stroke can be set by turning the potentiometer clockwise (CW) to a maximum of 80% k_{vs} .

Caution ⚠

Do not under any circumstances use potentiometer Rv to limit the stroke on expansion applications. It must be possible to close the valve fully!

Forced control input ZC

		ZC – Function		
		No function	Fully open	Closed
Connections				
	Transfer			
function		<ul style="list-style-type: none"> ZC not connected Valve will follow the Y-signal Minimum stroke set-ting with potentiometer Rv possible 	<ul style="list-style-type: none"> ZC connected to G Valve will fully open control path A → AB 	<ul style="list-style-type: none"> ZC connected to G0 Valve will close control path A → AB

Signal priority

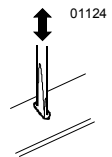
1. Forced control signal ZC
2. Signal input Y and/or minimum stroke setting with potentiometer Rv possible.

Calibration

The printed circuit board of the MVL661..EX has a slot to facilitate calibration. To calibrate, insert a screwdriver in the slot so that the contacts inside are connected. As a result, the valve will first be fully closed and then fully opened.

Calibration matches the electronics to the valve mechanism.

During calibration, the green LED flashes for about 10 seconds; refer to "Indication of operating state" (page 4).



MVL661..EX refrigerant valves are supplied fully calibrated.

When is a calibration required?

Execute a calibration after replacing the electronics, when the red LED is lit or flashing or when the valve is leaking (at seat).

Indication of operating state

LED	Indication	Function	Remarks, troubleshooting
Green	Lit	Control mode	Automatic operation; everything o.k.
	Flashing	Calibration in progress	Wait until calibration is finished (green or red LED will be lit)
Red	Lit	Calibration error Internal error	Recalibrate (operate button in opening 1x) Replace electronics module
	Flashing	Mains fault	Check mains network (outside the frequency or voltage range)
Both	Dark	No power supply Electronics faulty	Check mains network, check wiring Replace electronics module

Connection type ¹⁾

Always give preference to a 4-wire connection!

4-wire connection
3-wire connection

Product number	S_{NA} [VA]	P_{MED} [W]	S_{TR} [VA]	P_{TR} [W]	I_F [A]	Wire cross-section [mm ²] 1,5 2,5 4,0 ²⁾ max. cable length L [m]		
						1,5	2,5	4,0
MVL661..EX	32	12	≥ 50	≥ 40	1,6...4 A	65	110	160
MVL661..EX	32	12	≥ 50	≥ 40	1,6...4 A	20	35	50

S_{NA} = Nominal apparent

P_{med} = Typical power consumption (Application)

S_{TR} = Minimum transformer apparent power

P_{TR} = Minimum DC power output

I_F = Minimum required slow-blow fuse

L = Max. cable length; with 4-wire connections, the max. permissible length of the separate 1.5 mm² copper positioning signal wire is 200 m

¹⁾ All information at AC 24 V or DC 24 V

²⁾ With 4 mm² electrical wiring reduce wiring cross-section for connection inside valve to 2.5 mm².

For accurate valve sizing, we recommend using the "Refrigeration VASP" software sizing tool, available from your local Siemens office.

Engineering notes

Depending on the application, additional installation instructions may need to be observed and appropriate safety devices (e.g. pressure switches, full motor protection, etc.) fitted.

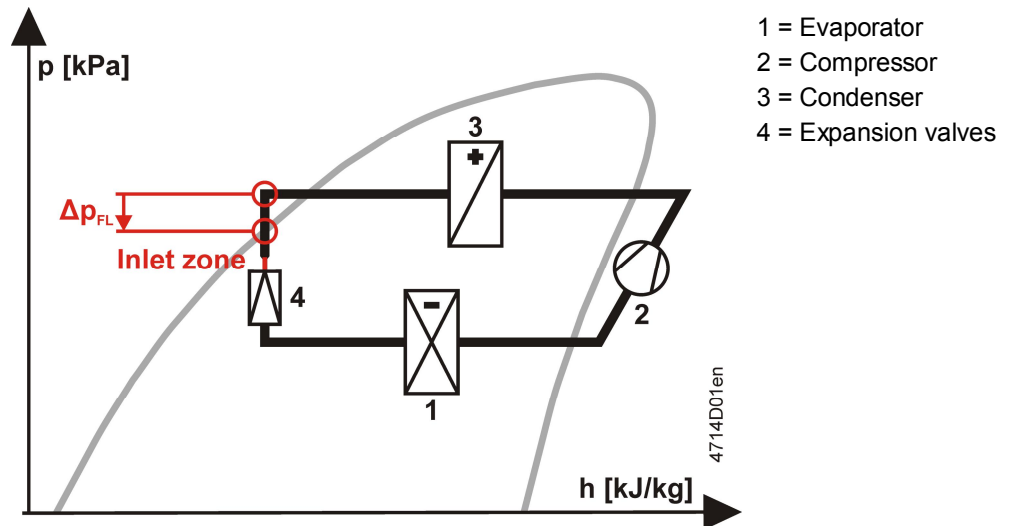
Warning 

To prevent damage to the seal inside the valve insert, the plant must be vented on the low-pressure side following a pressure test (valve port AB), or the valve must be fully open during the pressure test and during venting (power supply connected and positioning signal at maximum or forced opening by G → ZC).

Expansion application

To prevent formation of flash gas on expansion applications, the velocity of the refrigerant in the fluid pipe may not exceed 1 m/s. To assure this, the diameter of the fluid pipe must be greater than the nominal size of the valve, using reducing pieces for making the connections to the valve.

Engineering notes



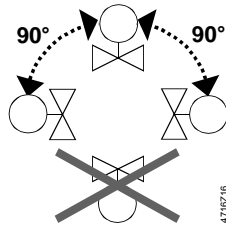
- a) The differential pressure over reduction must be less than half the differential pressure Δp_{FL} .
- b) The inlet path between diameter reduction and expansion valve inlet
 - Must be straight for at least 600 mm
 - May not contain any valves

**A filter / dryer must be mounted upstream of the expansion valve.
The valve is not certified for ammonia (NH3, R717).**

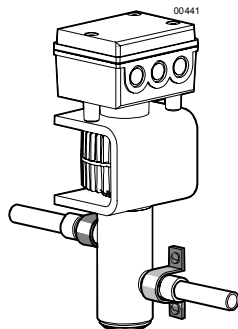
Use only properly qualified technicians to mount and commission the valve. The same applies to replacement electronics and configuring the controller (e.g. SAPHIR or PolyCool).



Comply with all requirements per EN 60079-14 for use/installation of the valve. Additional installation notes may also need to be observed as well as the use of proper safety elements (e.g. pressure switches, motor protection) depending on the particular application.

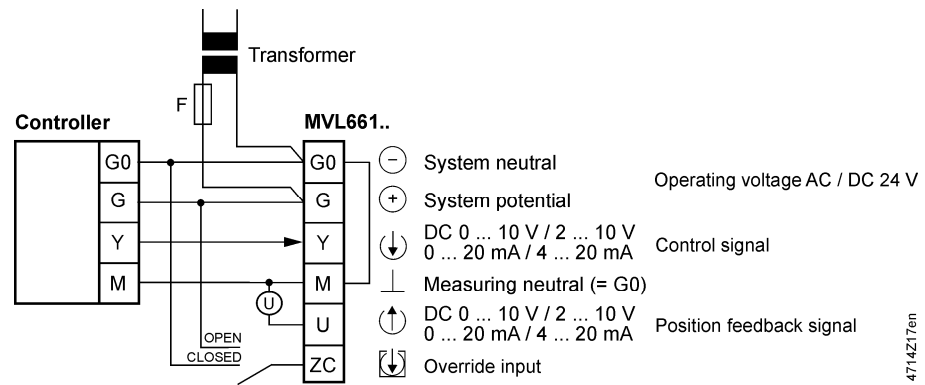


- The refrigerant valves can be mounted in any orientation, but upright mounting is preferable.
- Arrange the pipe work in such a way that the valve is not located at a low point in the plant where oil can collect.
- The pipes should be fitted in such a way that the alignment does not distort the valve connections. Fix the valve body so that that it cannot vibrate. Vibration can lead to burst connection pipes.
- Before soldering the pipes, ensure that the direction of flow through the valve is correct.
- The pipes must be soldered with care. To avoid dirt and the formation of scale (oxide), inert gas is recommended for soldering.
- The flame should be large enough to ensure that the junction heats up quickly and the valve does not get too hot.
- The flame should be directed away from the valve.
- During soldering, cool the valve with a wet cloth, for example, to ensure that it does not become too hot.
- Port B must be sealed off when a 2-port valve (AB → A) is used.
- The valve body and the connected pipe work should be lagged.
- The actuator must not be lagged.
- The valve has a mechanical shut-off function that is Normally Closed (NC) without power. This must be observed during commissioning and servicing work.



The valve is supplied complete with mounting instructions A5W00034455.

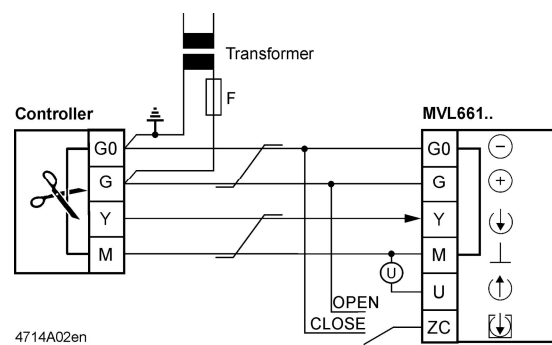
Connection terminals



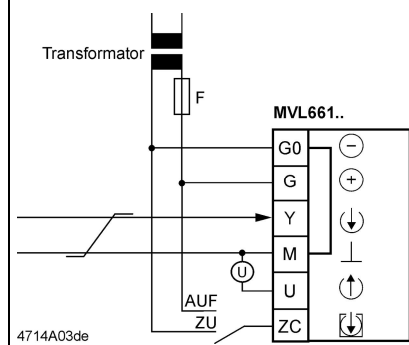
Connection diagrams

Terminal assignment for controller with 4-wire connection (to be preferred!)

Common transformer

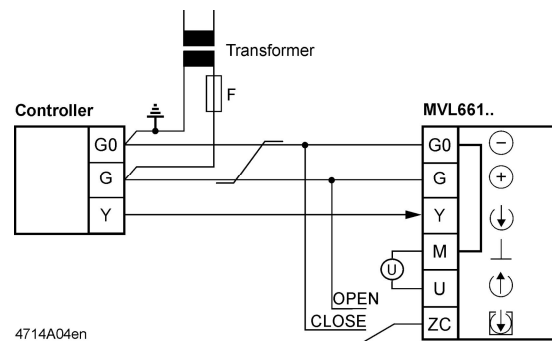


Separate transformer

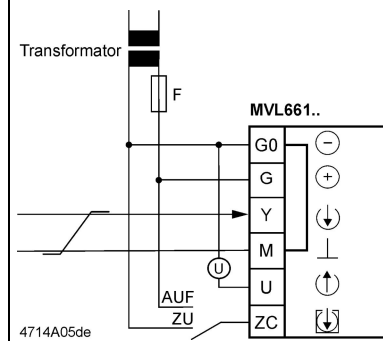


Terminal assignment for controller with 3-wire connection

Common transformer



Separate transformer



- Indication of valve position (only if required). DC 0...10 V → 0...100% volumetric flow V100
- Twisted pairs. If the lines for AC 24 V power supply and the DC 0...10 V (DC 2...10 V, DC 0...20 mA, DC 4...20 mA) positioning signal are routed separately, the AC 24 V line need not be twisted.

Warning

DIL switch

Piping must be connected to potential earth!

Factory setting: Valve characteristics equal-percentage, positioning signal DC 0...10 V. Details see "Configuration DIL switches", page 3.

Calibration

See "Calibration", page 4.



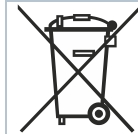
Special conditions of safe use for Ex Equipment

Cabling and conduits	The MVL661 *** refrigerating valve are to be connected via cable and corresponding Ex certified cable glands suitable for this purpose.
Cable and conduit entries	The unused inlet openings with predefined breakouts locations shall be closed with separate "Ex e" sealing plugs.
Protection class	The degree of protection (solid foreign objects, dust and water protection) according to IEC / EN 60529, at least IP 65 during installation and operation, is achieved only if the cable and wiring entries and, if applicable, blanking elements are correctly used.
Protection against UV radiation	The refrigerating valves MVL661 *** and MVS661 must be installed in such a way that it is adequately protected against sunlight or other sources of UV radiation.
Exceeding rated voltage	Actions must be taken either within or outside of the equipment (cold valve MVL661 *** and MVS661 ***) which prevent the rated voltage from exceeding transient faults by more than 40% (transient protection).
Environment	In order not to exceed the maximum permissible temperatures on the electronics housing and the solenoid valve, the valve must be installed lying (horizontal) at $40\text{ ° C} < T_{amb} < 55\text{ ° C}$ and $80\text{ ° C} < T_{med} < 120\text{ ° C}$.
Cleaning	Due to the risk of electrostatic charging, the appliance may only be cleaned with a damp cloth.
Grounding	It is ensure that the refrigerating valve is earthed through the pipe fittings.
Housing protection	At the temperature range of $-25\text{ ° C} \leq T_{amb} \leq -15\text{ ° C}$ the electronic enclosure must be protected against impacts.

Maintenance notes

	The refrigerant valve is maintenance-free.
Valve repair	The valve cannot be repaired; the entire unit must be replaced.
Replacement electronics	Simply exchange the connection housing on a defective valve electronics with the replacement part ASR61EX. The replacement electronics include mounting instructions A5W00036611.
Warning	Do not plug in or remove the connection housing when connected to power. A calibration must be triggered after replacing to ensure the electronics are optimally matched to the valve (See "Calibration", page Fehler! Textmarke nicht definiert.).
Warning	actuator gets hot at operating states at the edge of the application data, but there is no risk of fire. Maintain a minimum distance to wall, see "Dimensions".

Disposal



The valve is considered an electronics device for disposal in terms of European Directive 2012/19/EU and may not be disposed of as domestic garbage.

- Dispose of the device through channels provided for this purpose.
- Comply with all local and currently applicable laws and regulations.

Warranty

Application-specific technical data must be observed.

If specified limits are not observed, Siemens Building Technologies / CPS Products will not assume any responsibility.

Technical data

Functional actuator data


Power supply	Extra low-voltage only (SELV, PELV)	
AC 24 V	Operating voltage	AC 24 V \pm 20% (SELV) or AC 24 V class 2 (US)
	Frequency	45...65 Hz
	Typical power consumption P_{med}	12 W
	Standby	< 1 W (valve closed)
	Rated apparent power S_{NA}	32 VA (for selecting the transformer)
	Required fuse	1.6...4 A (slow)
	External supply line protection	Fuse slow max. 10 A or Circuit breaker max. 13 A Characteristic B, C, D according to EN 60898 or Power source with current limitation of max. 10 A
	DC 24 V	Operating voltage
		DC 20...30 V
	Current draw	0.5 A / 2 A (max.)
Signal inputs	Control signal Y	DC 0/2...10 V or DC 0/4...20 mA
	Impedance DC 0/2...10 V	100 k Ω / 5nF
	Impedance DC 0 / 4...20 mA	240 Ω / 5nF
	Forced control ZC	
	Input impedance	22 k Ω
	Close valve (ZC connected to G0)	< AC 1 V; < DC 0.8 V
	Open valve (ZC connected to G)	> AC 6 V; > DC 5 V
	No function (ZC not wired)	Positioning signal Y active
Signal outputs	Position feedback signal U	Voltage DC 0/2...10 V; load resistance \geq 500 Ω Current DC 0/4...20 mA; load resistance \leq 500 Ω
	Stroke detection	Inductive
	Nonlinearity	Accuracy \pm 3 % full scale
Positioning time	Positioning time	< 1 s
Electrical connections	Cable entry glands	3 x \varnothing 17 mm (for M16)
	Max. cable length	See «Connection type», page 5
	Minimum wire cross-section ¹⁾	0.75 mm ²
	Maximum wire cross-section ¹⁾	2.5 mm ²
	Tightening torque (terminal block)	0.5 – 0.6 Nm ¹⁾
Product data valve	Permissible operating pressure	max. 4,5 MPa (45 bar) ²⁾
	Max. differential pressure Δp_{max}	2.5 MPa (25 bar) MVL661.32-10: 1.6 MPa (16 bar) MVL661.32-12: 200 kPa (2 bar)
	Valve characteristic (stroke, k_v)	Linear (to VDI / VDE 2173)
	Leakage rate (internally across seat)	max. 0.002% k_{vs} or max. 1 NI/h gas at $\Delta p = 400$ kPa (4 bar) Shut/off function, like solenoid normally closed (NC) function
	External seal	Hermetically sealed (fully welded, no static or dynamic seals)
	Permissible media	Commonly used safety refrigerants (R22, R134a, R227ea, R404A, R407C, R410A, R422D, etc.) and R744 (CO ₂). Not suitable for ammonia (R717).
	Media temperature at valve inlet (A)	-0...120 °C; max. 140 °C for 10 min

Materials

Pipe connections

Dimensions and weight

Norms and directives

Media temperature at valve outlet (AB)	-40..120 °C; max. 140 °C for 10 min
Stroke resolution ^{AH} / _{H100}	1 : 1000 (H = stroke)
Hysteresis	Typically 3 %
Mode of operation	Modulating
Position when deenergized	Control path A → AB closed
Orientation	Upright to horizontal ³⁾
Valve body and parts	Steel / CrNi steel
Seat / piston	CrNi steel / brass
Sealing disk	PTFE
Sleeves	Internally soldered, CrNi steel
	See "Dimensions" page 13
Electromagnetic compatibility (Application)	For residential, commercial and light-industrial environments
Product standard	EN60730-x
EU Conformity (CE)	CA2T4714xx ⁴⁾
Electrical safety	EN 60730-1
Protection class	Class III as per EN 60730
Degree of pollution	Degree 2 as per EN 60730
Housing protection	
Upright to horizontal	IP65 as per EN 60529 ³⁾
Vibration ⁵⁾	EN 60068-2-6 5 g acceleration, 10...150 Hz, 2.5 h (5 g horizontal, max. 2 g upright)
Environmental compatibility	The product environmental declarations CA2E4714.1en und CA2E4714.2en contains data on environmentally compatible product design and assessments (RoHS compliance, materials composition, packaging, environmental benefit, disposal).
ATEX directive area	2014/34/EU ⁶⁾
ATEX certification	 II 3G Ex ec IIC T4 Gc SEV 17 ATEX 0110 X
Housing protection	Electronics ⁷⁾
Permissible operating pressure	PED 2014/68/EU
Pressure accessories	Scope: Article 1, section 1 Definitions: Article 2, section 5
Fluid group 1	Without CE-marking as per article 4, section 3 (sound engineering practice)

General

environmental conditions

	Operation EN 60721-3-3	Transport EN 60721-3-2	Storage EN 60721-3-1
Climatic conditions	Class 3K6	Class 2K3	Class 1K3
Temperature	-25...55 °C ⁷⁾	-25...70 °C	-5...45 °C
Humidity	10...100% r. h.	< 95% r. h.	5...95% r. h.

¹⁾ Use the appropriate ferrules on multistrand wiring. Use the appropriate double ferrules when using two wires per connection..

²⁾ To EN 12284 tested with 1,43 x operating pressure at 90 bar

³⁾ At 40 °C < Tamb < 55 °C and 80 °C < Tmed < 120 °C the valve must be installed on its side to avoid shortening the service life of the valve electronics

⁴⁾ The documents can be downloaded from <http://siemens.com/bt/download>.

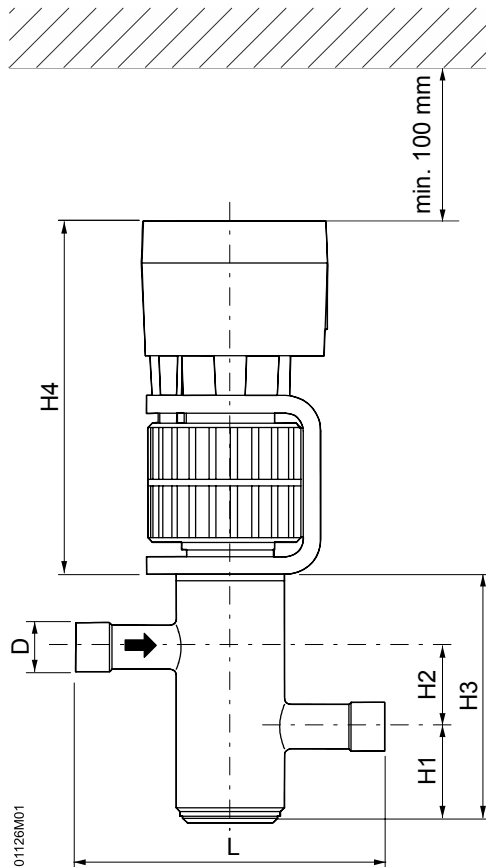
⁵⁾ Use high-flex stranded wires for safety reasons.

⁶⁾ Comply with the special conditions on page 9 and requirements per EN 60079-14 on applications in potentially explosive atmospheres.

⁷⁾ The electronic housing must be protected against shock waves at a temperature range of -25 °C ≤ Tamb ≤ -15 °C.

Dimensions

Dimensions in mm



Type reference	DN	D [inch]	L [mm]	H1 [mm]	H2 [mm]	H3 [mm]	H4 [mm]	T [mm]	M [kg]
MVL661.15-0.4EX	15	5/8"	140	44	36	113	160	103	4.4
MVL661.15-1.0EX	15	5/8"	140	44	36	113	160	103	4.4
MVL661.20-2.5EX	20	7/8"	150	41	41	119	160	103	4.5
MVL661.25-6.3EX	25	1 1/8"	160	40	47	126	160	103	4.6

DN Nominal size

D Pipe connections [inch], internal dimension

T Depth

M Weight including packaging [kg]

ATEX label



Siemens Switzerland Ltd, 6300 Zug, Switzerland
Type MVL661*** / MVS661***

II 3G Ex ec IIC T4 Gc
SEV 17 ATEX 0110 X

WARNING – POTENTIAL
ELECTROSTATIC CHARGING

Revision numbers

Product number	Valid from rev. no.
MVL661.15-0.4EX	..A
MVL661.15-1.0EX	..A
MVL661.20-2.5EX	..A
MVL661.25-6.3EX	..A

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